

In the Claims

Applicant has submitted a new complete claim set as follows.

1. (Currently amended) Image sensing apparatus comprising:
at least ~~one~~ an image pickup plate disposed generally laterally with respect to a direction of movement of an object; and
a plurality of image drive plates in spaced relation to said image pickup plate to define a plurality of sensor gaps between respective image drive plates and said image pickup plate, wherein features of the object passing over said sensor gaps produce a change in capacitance between respective image drive plates and said image pickup plate.
2. (Currently amended) Image sensing apparatus as defined in claim 1, wherein said ~~at least one~~ image pickup plate and said plurality of image drive plates are dimensioned and spaced for sensing a fingerprint.
3. (Original) Image sensing apparatus as defined in claim 2, wherein a spacing between each of said image drive plates and said image pickup plate is less than about one half of the ridge spacing on a typical fingerprint.
4. (Original) Image sensing apparatus as defined in claim 2, wherein a spacing between adjacent ones of said image drive plates is less than about one half of the ridge spacing on a typical fingerprint.
5. (Original) Image sensing apparatus as defined in claim 1, wherein said image drive plates comprise parallel conductors disposed perpendicular to said image pickup plate and spaced from said image pickup plate by respective sensor gaps.
6. (Currently amended) Image sensing apparatus as defined in claim 1, wherein said ~~at least one~~ image pickup plate comprises two or more image pickup plates disposed generally laterally with respect to the direction of movement of the object.

7. (Original) Image sensing apparatus as defined in claim 2, including at least about 250 image drive plates.
8. (Currently amended) Image sensing apparatus as defined in claim 1, further comprising a substrate, wherein said ~~at least one~~ image pickup plate and said plurality of image drive plates comprise conductive traces on said substrate.
9. (Original) Image sensing apparatus as defined in claim 8, wherein said substrate comprises a printed circuit board.
10. (Original) Image sensing apparatus as defined in claim 8, wherein said substrate comprises a flexible substrate.
11. (Original) Image sensing apparatus as defined in claim 10, further comprising a substrate support, wherein said flexible substrate is affixed to said substrate support and wherein said substrate support has a contour selected to substantially match the contour of a typical finger.
12. (Original) Image sensing apparatus as defined in claim 1, further comprising:
an excitation circuit for sequentially energizing said image drive plates with drive signals,
and
a detection circuit for detecting the drive signals capacitively coupled from said image drive plates to said image pickup plate to provide image signals.
13. (Original) Image sensing apparatus as defined in claim 12, wherein said drive signals comprise sequential signal bursts applied to respective ones of said image drive plates.
14. (Original) Image sensing apparatus as defined in claim 13, wherein said excitation circuit includes circuitry for coupling non-energized image drive plates to a reference potential.
15. (Original) Image sensing apparatus as defined in claim 13, wherein said signal bursts comprise bursts of a clock signal.

16. (Original) Image sensing apparatus as defined in claim 13, wherein said detection circuit comprises a synchronous detector for providing pulses in response to the detected signal bursts.

17. (Original) Image sensing apparatus as defined in claim 16, further comprising an analog-to-digital converter for converting said pulses to digital values, a memory and a processor for storing the digital values in said memory.

18. (Original) Image sensing apparatus as defined in claim 17, wherein said processor initiates a plurality of sequential line scans of said image drive plates to provide a plurality of line scans along lines of the moving object.

19. (Original) Image sensing apparatus as defined in claim 12, wherein said detection circuit includes an amplifier for receiving the capacitively coupled drive signals, said amplifier having a gain that is an inverse function of the amplitude of the capacitively coupled drive signals.

20.-34. Cancelled

35. (Currently amended) A fingerprint sensing system comprising:

an image sensor comprising ~~a linear~~ an array of capacitive sensors for capacitive sensing of ridge peaks and ridge valleys of a fingerprint on a moving finger, said image sensor comprising:

an image pickup plate disposed generally laterally with respect to a direction of movement of the finger; and

a plurality of image drive plates in spaced relation to said image pickup plate to define a plurality of sensor gaps between respective image drive plates and said image pickup plate, wherein ridge peaks and ridge valleys of the fingerprint passing over said sensor gaps produce a change in capacitance between respective image drive plates and said image pickup plate;

a ~~rate-finger~~ sensor for sensing a speed of the finger as it moves across said image sensor;
and

a sensor circuit for excitation of said image sensor with image drive signals and for detection of image signals in response to said image drive signals, for excitation of said ~~rate~~ finger sensor with ~~rate~~ finger drive signals and for detection of ~~rate~~ finger signals in response to said ~~rate~~ finger drive signals, and for coordinating said image signals and said ~~rate~~ finger signals to provide a fingerprint image.

36. Cancelled

37. (Currently amended) A fingerprint sensing system as defined in claim 3635, wherein a spacing between each of said image drive plates and said image pickup plate is less than about one half of the ridge spacing on a typical fingerprint.

38. (Currently amended) A fingerprint sensing system as defined in claim 3635, wherein a spacing between adjacent ones of said image drive plates is less than about one half of the ridge spacing on a typical fingerprint.

39. (Currently amended) A fingerprint sensing system as defined in claim 3635, wherein said image drive plates comprise parallel conductors disposed perpendicular to said image pickup plate and spaced from said image pickup plate by respective sensor gaps.

40. (Currently amended) A fingerprint sensing system as defined in claim 3635, wherein said at least one image pickup plate comprises two or more image pickup plates disposed generally laterally with respect to the direction of movement of the finger.

41. (Currently amended) A fingerprint sensing system as defined in claim 3635, including at least about 250 image drive plates.

42. (Currently amended) A fingerprint sensing system as defined in claim 3635, further comprising a substrate, wherein said at least one image pickup plate and said plurality of image drive plates comprise conductive traces on said substrate.

43. (Original) A fingerprint sensing system as defined in claim 42, wherein said substrate comprises a flexible substrate.

44. (Original) A fingerprint sensing system as defined in claim 43, further comprising a substrate support, wherein said flexible substrate is affixed to said substrate support and wherein said substrate support has a contour selected to substantially match the contour of a typical finger.

45. (Currently amended) A fingerprint sensing system as defined in claim ~~36~~35, wherein said sensor circuit comprises:

an excitation circuit for sequentially energizing said image drive plates with said image drive signals, and

a detection circuit for detecting the image drive signals capacitively coupled from said image drive plates to said image pickup plate to provide said image signals.

46. (Original) A fingerprint sensing system as defined in claim 45, wherein said image drive signals comprise sequential signal bursts applied to respective ones of said image drive plates.

47. (Original) A fingerprint sensing system as defined in claim 46, wherein said excitation circuit includes circuitry for coupling non-energized image drive plates to a reference potential.

48. (Original) A fingerprint sensing system as defined in claim 46, wherein said detection circuit comprises a synchronous detector for providing pulsed image signals.

49. (Original) A fingerprint sensing system as defined in claim 48, wherein said sensor circuit further comprises an analog-to-digital converter for converting said pulsed image signals to digital values, a memory and a processor for storing the digital values in said memory.

50. (Original) A fingerprint sensing system as defined in claim 49, wherein said processor initiates a plurality of sequential line scans of said image drive plates to provide a plurality of line scans along lines of the moving finger.

51. (Original) A fingerprint sensing system as defined in claim 45, wherein said detection circuit includes an amplifier for receiving the capacitively coupled image drive signals, said amplifier having a gain that is an inverse function of the amplitude of the capacitively coupled image drive signals.

52. (Currently amended) A fingerprint sensing system as defined in claim 35, wherein said ~~rate-finger~~ sensor comprises:

two or more finger detectors spaced apart along a direction of movement of the finger, each of said finger detectors including at least one ~~rate-finger~~ drive plate and at least one ~~rate-finger~~ pickup plate, wherein an end of the finger passing over each of said finger detectors produces a change in capacitance between respective ~~rate-finger~~ drive plates and ~~rate-finger~~ pickup plates.

53. (Currently amended) A fingerprint sensing system as defined in claim 52, wherein the ~~rate-finger~~ drive plate and the ~~rate-finger~~ pickup plate of each of said finger detectors are disposed generally laterally with respect to the direction of movement of the finger.

54. (Currently amended) A fingerprint sensing system as defined in claim 52, wherein the ~~rate-finger~~ pickup plates of said finger detectors are commonly connected.

55. (Currently amended) A fingerprint sensing system as defined in claim 52, wherein each of said finger detectors includes first and second ~~rate-finger~~ pickup plates disposed on opposite sides of the ~~rate-finger~~ drive plate to form a differential capacitive sensor.

56. (Currently amended) A fingerprint sensing system as defined in claim 55, wherein the ~~rate-finger~~ drive plates of said finger detectors are commonly connected.

57. (Currently amended) A fingerprint sensing system as defined in claim 52, wherein the ~~rate-finger~~ drive plates and the ~~rate-finger~~ pickup plates of said finger detectors are curved to substantially match the curve of a typical finger end.

58. (Currently amended) A fingerprint sensing system as defined in claim 52, further comprising a substrate, wherein said ~~rate-finger~~ drive plates and said ~~rate-finger~~ pickup plates comprise conductive traces on said substrate.

59. (Currently amended) A fingerprint sensing system as defined in claim 52, further comprising a flexible substrate, wherein said ~~rate-finger~~ drive plates and said ~~rate-finger~~ pickup plates comprise conductive traces on said flexible substrate.

60. (Currently amended) A fingerprint sensing system as defined in claim 52, wherein said sensor circuit comprises:

an excitation circuit for energizing the ~~rate-finger~~ drive plates of said finger detectors with said ~~rate-finger~~ drive signals, and

a detection circuit for detecting the ~~rate-finger~~ drive signals capacitively coupled from the ~~rate-finger~~ drive plate to the ~~rate-finger~~ pickup plate of each of said finger detectors to provide said ~~rate-finger~~ signals.

61. (Currently amended) A fingerprint sensing system as defined in claim 60, wherein said ~~rate-finger~~ drive signals comprise signal bursts.

62. (Original) A fingerprint sensing system as defined in claim 61, wherein said detection circuit comprises a synchronous detector.

63. (Currently amended) A fingerprint sensing system as defined in claim 60, wherein said sensor circuit further comprises a processing circuit for detecting a time delay between said ~~rate-finger~~ signals from said finger detectors, wherein said time delay between said ~~rate-finger~~ signals is representative of the speed of the finger.

64. (Currently amended) A fingerprint sensing system as defined in claim 35, further comprising a substrate, wherein said image sensor and said ~~rate-finger~~ sensor are fabricated on said substrate.

65. (Original) A fingerprint sensing system as defined in claim 64, wherein said substrate comprises a flexible substrate.

66. (Original) A fingerprint sensing system as defined in claim 64, wherein said sensor circuit is mounted on said substrate.

67. (Currently amended) A fingerprint sensing method, comprising the steps of:
capacitively sensing ridge peaks and ridge valleys of a fingerprint on a swiped finger with ~~a linear~~an array of capacitive sensors and providing image signals representative of a line of the fingerprint, the array of capacitive sensors comprising an image pickup plate and a plurality of image drive plates in spaced relation to the image pickup plate to define a plurality of sensor gaps between respective image drive plates and the image pickup plate; and
acquiring from the ~~linear~~ array of capacitive sensors image signals representative of multiple lines of the fingerprint to provide a fingerprint image.

68. (Currently amended) A fingerprint sensing method, ~~comprising the steps of:~~ as defined in claim 67, further comprising:
~~capacitively sensing ridge peaks and ridge valleys of a fingerprint on a swiped finger with a linear array of capacitive sensors and providing image signals;~~
sensing a speed of the finger as it is swiped across the ~~linear~~ array of capacitive sensors and providing ~~rate~~finger signals; and
coordinating the image signals and the ~~rate~~finger signals to provide a fingerprint image.

69. (Currently amended) Image sensing apparatus as defined in claim 1, wherein said ~~at least one~~ image pickup plate and said plurality of image drive plates are substantially coplanar.

70. Cancelled

71. (Currently amended) A fingerprint sensing system as defined in claim ~~36~~35, wherein said ~~at least one~~ image pickup plate and said plurality of drive plates are substantially coplanar.

72. (Currently amended) A fingerprint sensing system as defined in claim 52, wherein the ~~rate-finger~~ drive plate and the ~~rate-finger~~ pickup plate of each of said finger detectors are substantially coplanar.

73. (Currently amended) A capacitive sensor comprising:
~~at least one a~~ pickup plate; and
a plurality of drive plates in spaced relation to said pickup plate to define an array of sensor gaps between respective drive plates and said pickup plate, said pickup plate and said plurality of drive plates being substantially coplanar, wherein an object passing above said array of sensor gaps produces a change in capacitance between respective drive plates and said pickup plate.

74. (Original) A capacitive sensor as defined in claim 73, wherein said pickup plate and said plurality of drive plates comprise conductive traces on a substrate.

75. (Original) A capacitive sensor as defined in claim 74, wherein said substrate comprises a flexible substrate.

76. (Original) A capacitive sensor as defined in claim 73, wherein said pickup plate and said plurality of drive plates are dimensioned and spaced for sensing a fingerprint.

77. (Original) A capacitive sensor as defined in claim 73, wherein said array of sensor gaps comprises a linear array.

78. (Original) A capacitive sensor as defined in claim 76, wherein said sensor gaps have dimensions of about 25 to 50 micrometers.

79. (Currently amended) A fingerprint sensing system comprising:
an image sensor comprising ~~a linear~~ an array of capacitive sensors for capacitive sensing of ridge peaks and ridge valleys of a fingerprint on a moving finger;

a ~~rate-finger~~ finger sensor for sensing the speed of a finger as it moves across said image sensor, wherein said image sensor and said ~~rate-finger~~ finger sensor are fabricated on a single substrate; and
a sensor circuit, separate from said substrate, for operating said image sensor and said rate sensor to provide fingerprint data.

80. (Previously presented) A fingerprint sensing system as defined in claim 79, wherein said image sensor comprises:

an image pickup plate disposed generally laterally with respect to a direction of movement of the finger; and

a plurality of image drive plates in spaced relation to said image pickup plate to define a plurality of sensor gaps between respective image drive plates and said image pickup plate.

81. (Previously presented) A fingerprint sensing system as defined in claim 79, wherein said image pickup plate and said plurality of drive plates are substantially coplanar on said substrate.

82. (Currently amended) Fingerprint sensing apparatus comprising:

an image sensor comprising an image pickup plate disposed generally laterally with respect to a direction of movement of a finger; and a plurality of image drive plates in spaced relation to said image pickup plate to define ~~the~~ a plurality of sensor gaps between respective image drive plates and said image pickup plate, wherein said image pickup plate and said plurality of image drive plates are fabricated on a substrate; and

a sensor circuit, separate from said substrate, for excitation of said image sensor with image drive signals and for detection of image signals generated by said image sensor in response to said image drive signals.

83. (Previously presented) Fingerprint sensing apparatus as defined in claim 82, wherein said image pickup plate and said plurality of image drive plates are substantially coplanar on said substrate.

84. (Previously presented) A fingerprint sensor comprising:
a substrate;

an image pickup plate fabricated on said substrate and disposed generally laterally with respect to a direction of movement of a finger; and

a plurality of image drive plates fabricated on said substrate in spaced relation to said image pickup plate to define a plurality of sensor gaps between respective image drive plates and said image pickup plate.

85. (Previously presented) A fingerprint sensor as defined in claim 84, wherein said plurality of sensor gaps comprises a linear array of sensor gaps.

86. (Previously presented) A fingerprint sensor as defined in claim 84, wherein said image pickup plate and said plurality of image drive plates are substantially coplanar on said substrate.

87. (Currently amended) A fingerprint sensor as defined in claim 84, further comprising a ~~rate-finger~~ sensor, fabricated on said substrate, for sensing the speed of the finger as it moves across the sensor gaps.